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ABSTRACT

This paper is the first in a series to investigate the impact of state-of-the-art networking technologies in a reformed educational context on student learning, teacher instruction, and parental involvement. The findings presented in this report are based on standardized test results. Although the findings indicate that the reforms are having a substantial impact for all students in Union City, NJ, the role of technology is less clear. This report finds that a range of factors, both contextual and technology-facilitated, have made a difference in student performance. This report concludes with a discussion of the five elements that have been central to Union City's overall success. Contains 14 references. (ASK)

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THE UNION CITY STORY

Education Reform and Technology Students' Performance on Standardized Tests

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Children & Technology

THE UNION CITY STORY

Education Reform and Technology
Students' Performance on Standardized Tests

CCT REPORTS
April 1998

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Margaret Honey
Daniel Light
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Nancy Ross

Executive Summary

This school system is undergoing a remarkable transformation. I want the rest of the country to know about it, and I want everybody in the country to be able to emulate it.

President Bill Clinton
Address to Union City Schools
February 15, 1996

In February of 1996, President Clinton and Vice-President Gore selected Union City as the site from which to announce a new multi-billion-dollar initiative, *America's Education Technology Challenge*. Union City was recognized by the President for its comprehensive program of educational reform, which has resulted in remarkable improvements in student learning and achievement. Closely tied to the district's reform initiatives has been an innovative school-business partnership with the Bell Atlantic Corporation, known locally as *Project Explore*, that has pioneered the use of home-school networking technologies to provide students and teachers with in-depth access to communications and information resources.

This paper is the first in a series supported by the Jerry Lee Foundation[1] and the National Science Foundation[2] to investigate the impact of state-of-the-art networking technologies in a reformed educational context on students' learning, teachers' teaching and parental involvement.

The findings presented in this report are based on standardized test results. Although by no means a perfect measure of students' learning, standardized test results are frequently the bottom-line measure for many school districts, particularly urban ones. To examine the impact that the reforms have had on students' test performance, we look first at the changes in students' scores prior and subsequent to the district's reform initiatives. These analyses are based on tests administered by the district at the 1st, 4th, 8th, 9th, and 10th grade levels.

We then proceed with a more in-depth analysis based on a cohort of students who have had *sustained access to networked technology at home and at school* (Project Explore), and a cohort of students who have had more limited, *school only* (non-Explore) access to technology. The analyses presented here are based on testing data at the 7th through 10th grade levels.

[1] The Jerry Lee Foundation is a private foundation based in Philadelphia. The foundation is supporting CCT to carry out a series of studies on the impact of technology on urban youth.

[2] Union City Online: An Architecture for Networking and Reform is funded by the National Science Foundation's networking Infrastructure in Education Program, grant # REC 955-4327.

Our examination of the impact of the reforms and our investigation of the impact of technology on student learning indicate that:

- The educational reforms undertaken by the Union City district have had a substantial impact on students' standardized test performance, particularly at the K-8 level where the reforms have been in place the longest.
- The Explore students gain a substantial "leg up" during the first year of the project, scoring significantly better than their district peers in writing and mathematics. This increase is not due to the technology alone, but to increased expectations and to the dedication of teachers and administrators in ensuring that this group of students would excel.
- Writing is the one area where deep and sustained access to technology makes a difference. At the 7th, 8th, and 9th grade levels, Explore students do significantly better than their non-Explore peers on the writing portion of state tests.

While the findings clearly indicate that the reforms are having a substantial impact for all students in Union City, the role of technology is less clear. Although sustained access to technology has a measurable effect on students' middle school writing scores, students who have been in the district for a minimum of four years are performing at the same level as the Explore cohort by the 10th grade. In addition, although the Explore group appears to do significantly better than their district peers in mathematics, the cause is not technology-related. A subgroup of Explore students who participated in an Algebra I class as 8th graders do significantly better than Explore and non-Explore students who did not take this class. It is this Algebra I group that is responsible for raising the overall math scores of the entire Explore cohort. Finally, students who enter the Explore program in its second year (as 8th graders) never do as well as the 7th grade Explore entrants, nor do they perform significantly better than their district peers. This suggests that technology is not the sole cause of the Explore students' success; if it were we would see substantial gains among the 8th grade entrants to the Explore program.

This report finds that a range of factors, both *contextual* and *technology-facilitated*, have made a difference in the Explore students' performance.

Contextual factors include:

- The enthusiastic and dedicated staff at the Christopher Columbus Middle School, where Project Explore was launched
- High expectations for Explore students on the part of Bell Atlantic, district administrators, teachers, and a host of visitors from around the world
- The district's efforts to involve parents more extensively in the education of their children.

Technology-facilitated factors include:

- Increased communication between teachers, students, and parents
- Increased collaboration among teachers
- Additional opportunities to write and edit
- Additional opportunities to undertake multimedia authoring projects.

This report concludes by discussing five elements that have been central to Union City's overall success:

- Leadership and collaboration
- Strong base of teacher support
- Teachers at the center of curricular revision and school decision-making
- Sufficient funding from a variety of sources
- Attention to public relations.

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The Union City School District

Introduction

Union City, New Jersey, is located in Hudson County, directly across the Hudson River from Manhattan. With 42,000 residents per square mile, it is the most densely populated city in the United States. Its ethnic makeup is predominantly Cuban, although recent arrivals from the Caribbean, Central and South America, as well as longtime Italian residents add to the diversity of the population. Of the approximately 9,000 students in the district's eleven schools (three elementary, five K-8, one middle, and two high schools), 92% are Latino, 75% of whom do not speak English at home. The Brookings Institute classified Union City as one of the 92 most impoverished communities in the United States; 27.5% of all children live below the poverty line and 79% receive free or reduced lunches.

In 1989, having failed in 44 out of 52 categories the State of New Jersey uses to determine the efficacy of school districts, such as student attendance, dropout rates, and scores on standardized tests, the Union City School District was facing state takeover. Like many urban districts, Union City was also facing multiple obstacles to correcting these deficiencies, including language barriers, parents with limited formal education, and students with little incentive to stay in school.

Rather than lose local control of the school district, however, Union City decided to face these challenges head-on and drastically reform the entire educational system. The district formulated and implemented a five-year Corrective Action Plan (CAP) calling for systemic changes in the educational system. Using a whole language approach to learning, the district focused on creating a curriculum which would support the development of thinking, reasoning, and collaboration skills. In order to facilitate this curricular shift away from rote learning and lectures, classes were extended in most subject areas to 111-minute periods at the elementary and middle school level and 80-minute periods in the high schools; in-service training for teachers was increased from 8 hours a year to 40 hours; buildings were refurbished (windows replaced, classrooms and hallways painted, and individual student desks replaced by cooperative learning tables); and textbooks for individual students were replaced with class libraries.

Union City chose to implement the reforms first in the elementary classrooms; the district then added classes year by year until reform had reached every grade level. This decision meant that no student schooled in a cooperative learning environment entered a new grade only to face the former method of instruction, and that the district did not have to face on an unmanageable scale the inevitable headaches that arise during renovations and the first years of new curricula. It also meant that they were able to take the lessons learned from each successive implementation and apply them toward easing the transition in subsequent years.

Union City Public Schools Restructuring, 1989-1998

Curriculum and Methodology

Before	After
Skill-based	Whole Language
Basal Readers, Single Text	Authentic Literature, Multi-Texts
Memorization, Cumulative Knowledge	How to Learn, Research-based
Vertical, Lecture Format	Horizontal, Cooperative Learning

Time, Classroom Management, and Physical Layout

Before	After
Single, Isolated Periods of 37 Minutes (Reading, Language Arts, Spelling)	Blocks of Time, 74-111 Minutes (Communications/Social Studies)
Teacher Centered	Student Centered

Staff Development

Before	After
Limited: 4 Half-Day Sessions,	Five Levels of Training, Half Days,
2 Hours Each, Some after School	Saturdays, Ongoing

Management and Budget

Before	After
Centralized	Shared with School-based Improvement Teams (SITs)
$$$ on Consumables (Workbooks, etc.)	Nonconsumable Big Books, CD-ROMs, Computers

Technology

Before	After
Labs with "Experts"	Labs with "Experts" and Classroom Computer Centers
Occasional Use	Daily Use
Separate Curriculum	Total Integration into All Curricula

Parental Involvement

Before	After
Two Parent Nights	Two Parent Nights, Board Notes, Parent University

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Source: Union City Board of Education, 1995

In addition to the curriculum reforms, substantial increases in the district's operating budget have played a critical role in Union City's efforts. Over the past eight years, the budget for the Union City School District has increased from $37.8 million in 1989 to $100 million in 1997 as a direct result of the Quality Education Act (QEA). Prior to the QEA, funds were gathered through local taxes and then distributed to districts based on local spending. Under this funding structure, poorer districts, with limited tax bases, received a much smaller percentage of state funds than did wealthier suburban districts.

The state's first attempt to remedy these inequities was to mandate a series of local tax increases. This tax increase provided Union City with an additional $4 million for each of the 1990-91 and 1991-92 school years and brought badly needed start-up money to the early reform efforts. There is no doubt that the extra funding provided by local tax increases and the QEA played a role in enabling the Union City School District to implement both its curricular reforms and technology improvements.

Building the Telecommunications Infrastructure

In 1992, Bell Atlantic was in search of a testing ground for a multimedia distribution system to give subscribers access to interactive multimedia content over a packet-switched network. A school provided the ideal combination for the technology trial of access to a significant number of participants and an opportunity to contribute to the community in a significant and visible manner. After a series of meetings between the Union City Board of Education and Bell Atlantic, it was decided that the Union City School District would be home to the trial site.

In addition to the district's proven commitment to reform, Bell Atlantic was attracted by the combination of working in a new school building and curricula being rebuilt from beginning to end. By this time, education reforms were in a full swing in the district's elementary grades and about to begin in the middle grades. This meant that 7th and 8th grade teachers who had been watching and learning from reforms in the earlier grades would be hard at work during the summer rewriting the curricula, and would be supported by training to implement the new curricula. In order to alleviate overcrowding in two then K-8 school buildings, Union City had purchased an unused private school building to create its first middle school: Christopher Columbus. This meant that Bell Atlantic could install its wiring while the school was being refurbished prior to its opening without disrupting students, thus ensuring the presence of technology from the start so that teachers could incorporate it as an integral part of the curriculum from day one.

The Bell Atlantic technology trial, known locally as Project Explore, proceeded in three phases. For Phase 1 (1993-1994) of the trial, Bell Atlantic provided access to computers at home as well as at school. Altogether, Bell Atlantic provided two hundred 486-level computers equipped with telecommunications,

graphics, and sound capabilities, as well as basic software tools such as Microsoft Works. Forty-four computers were installed in Christopher Columbus classrooms while 135 were placed in 7th-grade students' homes (one for every student at that grade level attending Columbus), and 20 in teachers' homes. In addition, the district provided 30 additional 575 Macintosh computers with CD-ROMs for the computer lab and distributed another 40 to classrooms and offices. The end result in the school was two Macintosh computers and a networked 486 in each classroom, 35 Macs in the computer lab, and four more in the media resource room.

Phase 2 (1994-1995) saw the provision of high bit rate digital subscriber lines (T-1) and CD-ROM audio/video server technology and Internet access for these workstations both in school and at home.

Phase 3 (1995 - 1999) of the trial, which began in September of 1995, followed the students to Emerson High School, where 16 teachers agreed to participate in the trial. These teachers were given access to the network in their classrooms as well as at home. Bell Atlantic has agreed to continue support for Phase 3 through 1999, when the original cohort of students will complete their senior year at Emerson. As the students have advanced through grade levels, more teachers have been added to the trial and received computers and Internet access at home. Currently 35 teachers are participating in the trial at Emerson High School at the district's expense.

Project Explore Timeline

Early 1992	Initial Planning of Bell Atlantic Technology Trial
Summer 1993	Phase 1: Installation and teacher training
September 1994	Phase 2: Integration of T-1, testing of CD-ROM server technology
Spring 1995	CD-ROM server and Internet access
September 1995	Phase 3: Expansion of project to Emerson High School
October 1995	NSF award for "Union City Online: An Architecture for Networking and Reform"
March 1996	Union City Board of Education approves 1.2 million for FY 1996-97 for expansion of networking infrastructure
May 1996	Installation of Board of Education Internet server

Project Explore coincided with the commencement of a new telecommunications initiative in the district, the National Science Foundation-funded *Union City On-line: An Architecture for Networking and Reform*. A collaboration between the Union City School District, the EDC/Center for

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Children and Technology, and Bell Atlantic, the purpose of *Union City On-line* is to facilitate the spread of telecommunications technology to all schools in the district as well as to build capabilities within the district to support and maintain the telecommunications initiatives after the completion of Project Explore.

Currently, the Union City School District has built fiber backbones in each of its eleven schools. Approximately 25% of the 2,200 instructional computers — those in classrooms, media centers, and computer labs — are part of a Metropolitan Area Network (MAN) that connects the schools, two public libraries, city hall, and the local day care center through T-1 lines back to the central office server. With a ratio of four students per computer, computers in student and teacher homes, and increasing connectivity in the district, Union City is now one of the most, if not *the* most, wired urban school district in the United States. For the technological infrastructure to be of use, however, it was imperative to build and support the human infrastructure.

The changes in the district's philosophy and structure have been absolutely indispensable in priming classrooms for the creative and effective use of telecommunications technology. The restructured school day and change from the traditional teacher-centered model of learning to the student-centered, whole language approach provided the flexibility, time, and a research-driven curriculum that would make telecommunications technologies invaluable to the classroom. The implementation of education reforms in the district prior to the first significant introduction of telecommunications technology also ensured that structures for training and support were already firmly in place before the additional pressures of a new tool were added to the teachers' workload. In addition, the strong leadership and support demonstrated by district-level administrators when introducing new elements into the educational environment — whether new curricula or new computers, in the school or in the community — created an environment where administrators, teachers, students, and parents felt not only that the success of the community's schools was important, but also that each of them had the ability to help this success come about. By mandating and scaffolding key elements of new pedagogy and new technology rather than relying on a diffusion model, resistance was kept to a minimum and exploration, adoption and effective use were maximized.

Union City as a Research Testbed

The Education Development Center's Center for Children and Technology (CCT) first began to work with the Union City schools in 1992. The Center was brought into the district by Bell Atlantic to assist with the design and implementation of the Multimedia Education Trial. CCT staff have now worked for five years with a broad range of representatives of the Union City Board of Education and of the larger community, and have built successful working relationships with the district's individual schools as well as a range of community organizations.

The substantial investments in technology made by the Union City School District and its partners, coupled with the district's well-defined program of reform and restructuring, make Union City a fertile site for a comprehensive research program. This paper is the first in a series supported by the Jerry Lee Foundation[1] and the National Science Foundation[2] to investigate the impact of state-of-the-art networking technologies in a reformed educational context on students' learning, teachers' teaching, and parental involvement.

Union City's comprehensive reform efforts offer the opportunity to examine the impact of systemic reforms across the grade levels. Bell Atlantic's Project Explore provides a unique framework for looking at a group of students who have *sustained access to technology at home and at school* and a comparable group of students who have more limited, *school-only*, access to technology. All students, both those who have participated in Project Explore and those who have not, have been beneficiaries of the district's comprehensive reform agenda, and have been participating in a curriculum that emphasizes project work, critical analysis, and interpretation skills over rote memorization and practice.

In this paper, we have chosen to conduct an analysis of student achievement based on standardized testing data. Although by no means a perfect measure of students' learning, standardized test results are frequently the bottom-line measure for many school districts, particularly urban ones. Principals and superintendents use standardized test results as "community report cards," to represent how well their schools are doing in comparison to others in the state or county and to measure improvement in individual schools. State department officials use testing data to determine whether a district should be subject to special monitoring or, as is the case in New Jersey and many other states, to determine whether a district should be subject to state takeover. And policy makers often judge the effectiveness of their investments in education based on evidence culled from standardized tests.

The analyses presented in this paper are based on standardized tests administered by the district. To examine the impact that the reforms have had on students' test performance, we look first at the changes in students' scores prior and subsequent to the district's reform initiatives. These analyses are based on tests administered by the district at the 1st, 4th, 8th, 9th, and 10th grade levels.

We then proceed with a more in-depth analysis based on a cohort of students who have had sustained access to networked technology at home and at school (Project Explore), and a cohort of students who have had more limited, school only (non-Explore) access to technology. The analyses presented here are based on testing data at the 7th through 10th grade levels.

[1]The Jerry Lee Foundation is a private foundation based in Philadelphia. The foundation is supporting CCT to carry out a series of studies on the impact of technology on urban youth.

[2]The research presented here is partially supported by a National Science Foundation, Networking Infrastructure for Education grant (REC-9554327), "Union City Online: An Architecture for Networking and Reform."

Findings

New Jersey State Mandated Tests

Since 1988, the State of New Jersey has administered the Early Warning Test (EWT) to all 8th graders to identify students in need of supplemental instruction in reading, mathematics, and writing in preparation for the 11th grade High School Proficiency Test (HSPT) required for graduation. Like the High School Proficiency Test, the EWT is designed to measure students' knowledge and skills in three core subject areas: reading, mathematics, and writing. However, the EWT is specifically designed for the 8th grade. A student is placed in one of three proficiency levels for each subject depending on their score. Passing rates on the EWT refer to the number of students scoring within Level 1 or Level 2 proficiency levels. Both Levels 1 and 2 indicate satisfactory progress or better. Students in Level 3 are in need of supplemental instruction.

Union City uses the EWT in the 7th and 9th grades as well, to help in the early identification of students in need of supplemental instruction and to track students' progress as they approach the 8th grade EWT and 11th grade HSPT.

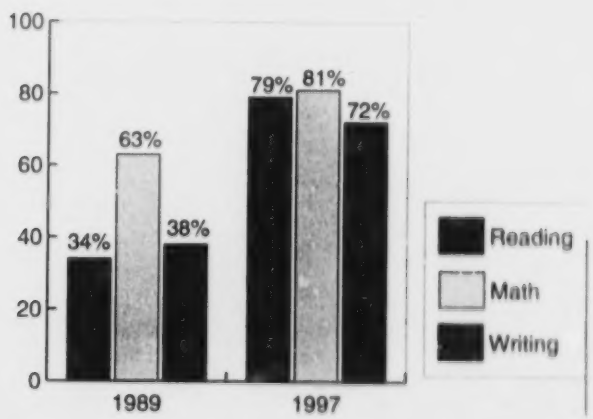
At the elementary level, the district is required by the State of New Jersey to test students at the 4th grade level. The district uses the California Achievement Test (CAT) to meet this requirement. In addition, although not required by the state, the district also administers the California Achievement Test to 1st graders.

District-Wide Measures of Progress

The Union City school district has completed its eighth year of reform and restructuring and students, particularly at the K-8 level, are demonstrating remarkable improvements in their standardized test scores.

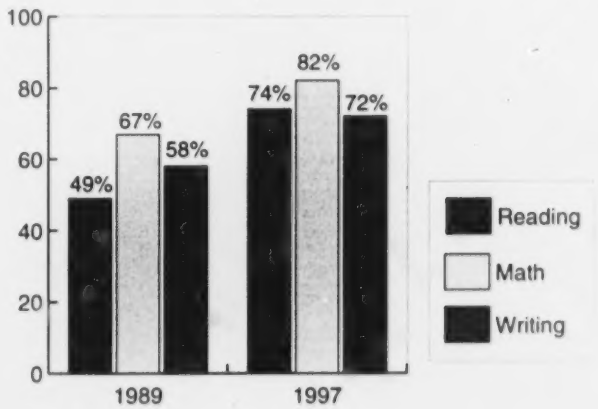
Between 1989 and 1997, on the 1st grade CAT Union City students have increased their scores by 45 percentile points in reading, 34 percentile points in writing, and 18 percentile points in math. First grade students are currently scoring in the 70th-80th percentile range in all three subject areas (see Figure 1).

Figure 1. 1989-97 1st Grade CAT National Percentile Comparison



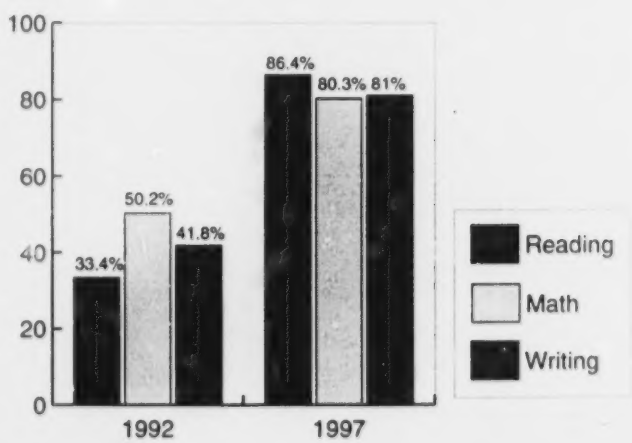
Fourth grade CAT scores show a similar trend. Between 1989 and 1997, 4th graders have increased their average scores by 25 percentile points in reading, 15 percentile points in math, and 14 percentile points in writing. Like the 1st graders, Union City 4th graders are scoring in the 70th-80th percentile range in all subject areas (see Figure 2).

Figure 2. 1991-97 4th Grade CAT National Percentile Comparison



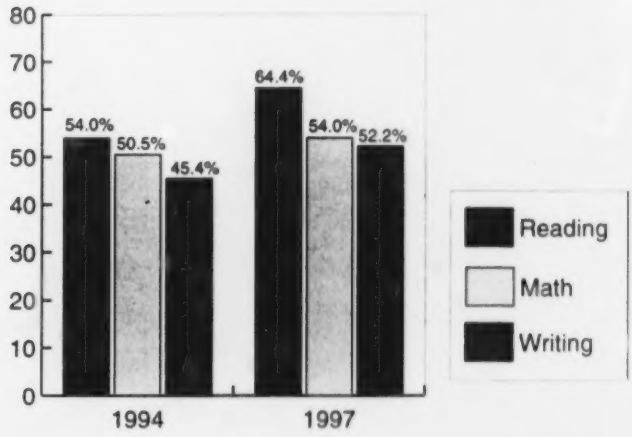
The most dramatic results have occurred at the 8th grade level. Between 1992, the year prior to the implementation of middle school reforms, and 1997, 8th grade students improved their average scores by 53 percentile points in reading, 30 percentile points in math, and 40 percentile points in writing. Eighth grade students are currently scoring in the 80th percentile range in all three subject areas (see Figure 3).

Figure 3. 1992-97 8th grade EWT Comparison



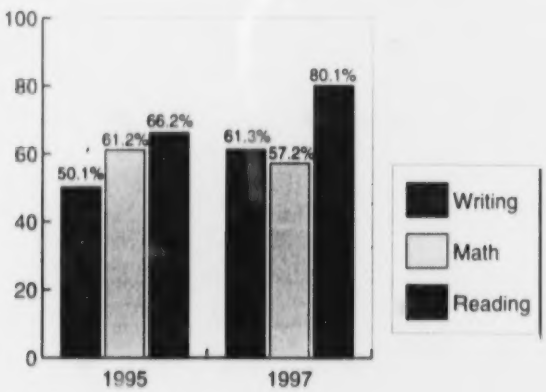
Results at the high school level have been more modest. This is not surprising given that the reforms have been in place for a much shorter period of time. Between 1994, the year prior to the high school reform efforts, and 1997, reading scores rose by 10 percentile points, math scores by 6 percentile points, and writing by 7 percentile points (see Figure 4).

Figure 4. 1994-97 9th Grade EWT Comparison



At the 10th grade level, students improved by 3 percentile points in reading, they declined 4 percentile points in math, but rose 14 percentile points in writing (see Figure 5).

Figure 5. 1994-97 10th Grade HSPT Comparison

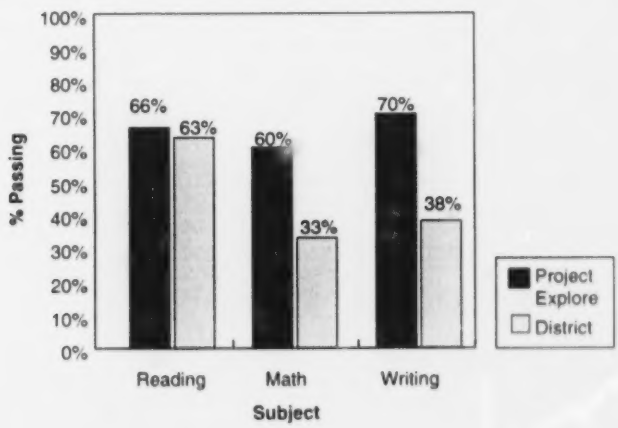


Project Explore

Previously reported data on the Union City Multimedia Trial indicated a fairly strong trend showing Project Explore students doing substantially better than the rest of the district (Honey & Henríquez, April 1996).

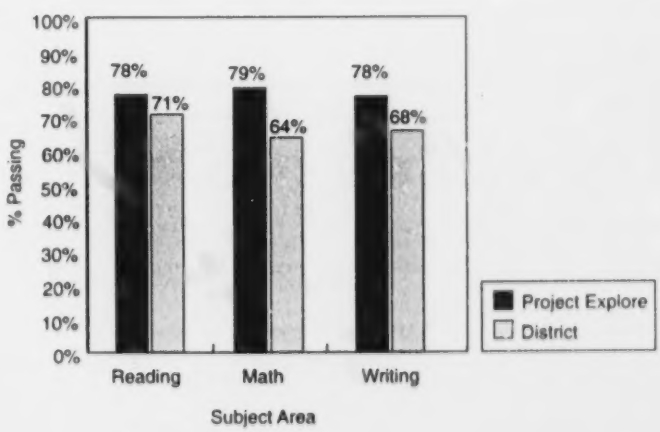
Looking at all students (including Limited English Proficiency), the Explore cohort had a higher percentage of students passing in every subject every year. The 7th grade results are particularly striking in mathematics and writing (see Figure 6). In the 7th grade (1994), Project Explore had 60% passing in mathematics and 70% in writing compared with district rates of 33% in mathematics and 38% in writing.

Figure 6.
Percentage of Students
Passing the 7th Grade EWT for Project Explore and District



In the 8th grade (1995), in each subject 78% of students tested at Levels 1 and 2. Project Explore students performed 15% higher in mathematics, 11% higher in writing, and 8% higher in reading (see Figure 7).

Figure 7. Percentage of Students
Passing the 8th Grade EWT for Project Explore and District



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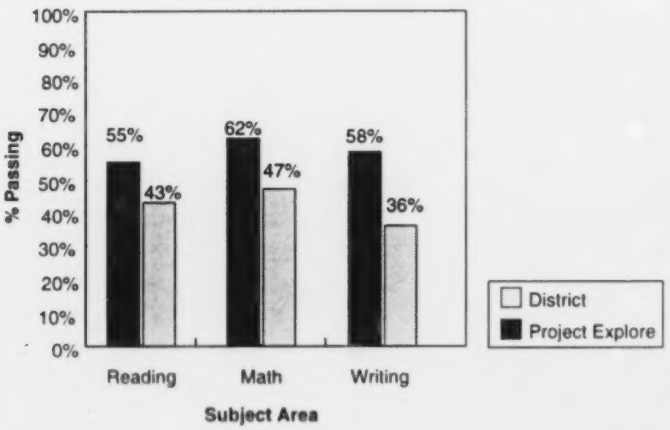
Again, in the 9th grade (1996), Explore students continued to outperform their district peers, scoring 22% higher in writing, 15% higher in mathematics, and 12% higher in reading (see Figure 8).

Figure 8.
Percentage of Students
Passing the 9th Grade EWT for Project Explore and District



Simple chi-square tests of association indicate a connection between belonging to Project Explore and passing the EWT in mathematics and writing at 7th, 8th, and 9th grade levels (see Tables 1, 2, and 3). It is only at the 9th grade level that a statistical association emerges in all three subject areas: reading, writing, and mathematics (see Table 3). In 1996, reading has a chi-square of 4.2 and is significant at the .05 level; mathematics has a chi-square of 7.03 and is significant at .05 level; and writing has a chi-square of 15.27 and is significant at the .05 level.

Table 1.
Chi-Square Test on Number of Students Passing the 7th Grade EWT for District Cohort and Project Explore

	Reading		Math		Writing	
	Not Passing	Passing	Not Passing	Passing	Not Passing	Passing
Project Explore	39	78	49	68	37	79
District	145	248	263	130	229	148
Total	184	326	312	198	266	227
df=1 cr=>6.635 *sign. at p=.01	Chi-Square= .496		Chi-Square= 23.8*		Chi-Square= 29.71*	

Table 2.
Chi-Square Test on Number of Students Passing the 8th Grade EWT for District Cohort and Project Explore

	Reading		Math		Writing	
	Not Passing	Passing	Not Passing	Passing	Not Passing	Passing
Project Explore	28	98	27	99	28	97
District	115	288	144	258	127	275
Total	143	386	171	357	155	372
df=1 cr=>3.84 *sign. at p=.05	Chi-Square= 1.94		Chi-Square= 9.07*		Chi-Square= 3.88*	

Table 3.
Chi-Square Test on Number of Students Passing the 9th Grade EWT for District Cohort and Project Explore

	Reading		Math		Writing	
	Not Passing	Passing	Not Passing	Passing	Not Passing	Passing
Project Explore	43	52	36	59	40	55
District	260	198	242	216	288	164
Total	303	250	278	275	328	219
df=1 cr=>3.84 *sign. at p=.05	Chi-Square= 4.2*		Chi-Square= 7.03*		Chi-Square= 15.27*	

These preliminary findings prompted us to undertake a more in-depth and controlled study of Explore and non-Explore student performance on standardized tests. In the remainder of this paper we compare individual test results for the Explore students to all non-Explore students at the same grade level and to randomly selected control groups drawn from Union City students with characteristics similar to the Explore cohort and Explore subgroups within this cohort.

General Characteristics of the Project Explore Cohort

Although similar to their Union City peers, Project Explore students are different in several important respects. There is a higher percentage of female students (51%) in the Explore cohort as compared to the district students at the same grade level (female: 46%). Project Explore also has a higher percentage of Limited English Proficiency (LEP) students (20%) than the district (14%), and a slightly greater percentage of Hispanic students (see Figures 9, 10, 11, 12).[3]

[3] These numbers represent all of the students who have ever been part of Project Explore, regardless of whether they have left the program. District figures are based on students

who were in the same grade as the Explore cohort.

Figure 9. Gender Characteristics of the Student Population

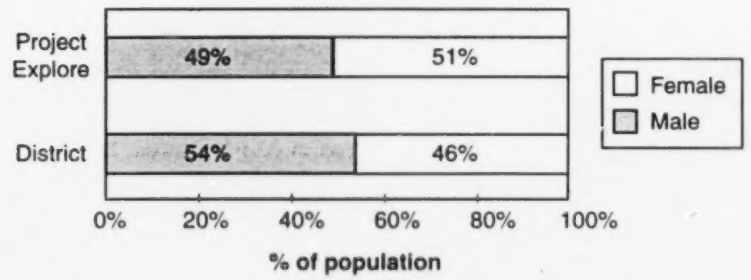


Figure 10. Percent of Limited English Proficiency Students in the Population

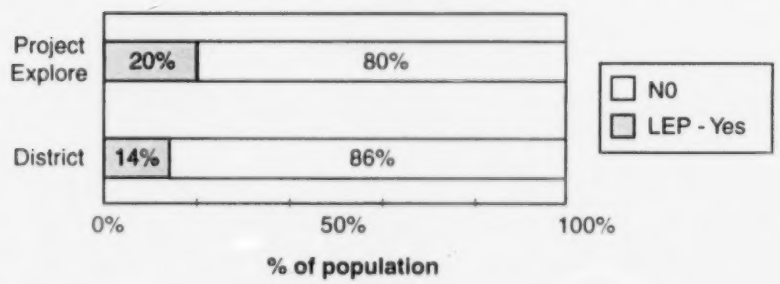


Figure 11. Ethnic Characteristics of Student Population

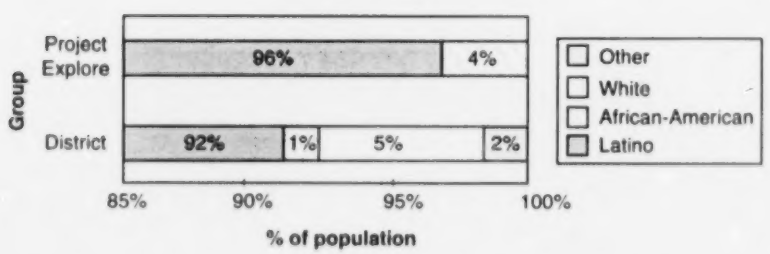
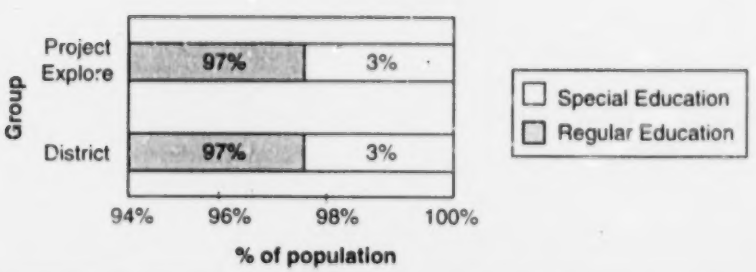


Figure 12. Percent of Special Education Students in the Population



In addition to comparing the Explore students with their district peers, we looked at Explore students who entered the program as 7th graders separately from those who joined a year later as 8th graders. The students who entered Project Explore in the 8th grade differ in two significant respects from the 7th grade entrants. First, there are more female students among 8th grade entrants (62%) than among 7th grade entrants (47%). Second, a greater percentage of 8th grade entrants are LEP (42% as compared with 12% of the 7th grade entrants). LEP status indicates that these students are newly arrived in the United States and will likely score lower on standardized tests than students who have been in the country longer (see Figures 13 & 14).

Figure 13. Gender Characteristics of Project Explore by Entry Cohort

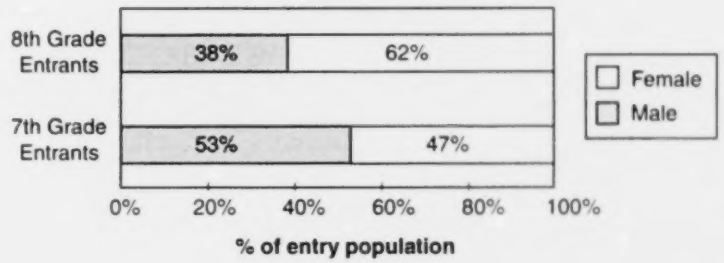
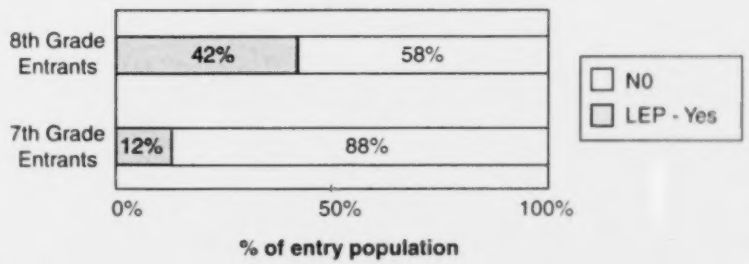


Figure 14 - Limited English Proficiency of Project Explore by Entry Cohort



The number of participants in Project Explore has varied over the years of the project. During the middle school years the numbers fluctuate as students move in and out of the Columbus School. After the Explore students enter Emerson High School the numbers decline as students move away from Union City or transfer to the county science magnet and other specialized high schools (see Table 4).

Table 4. Total Number of Students in Project Explore by Year

Year	Total
1993-94	135
1994-95	135
1995-96	99
1996-97	69

Sample Selection

The statistical analysis presented in this paper is based on the standardized testing cycle that the district uses (the EWTs and HSPTs). We collected test results for district students in the same grade as Project Explore students:

- All 7th grade students in 1994
- All 8th grade in 1995
- All 9th grade in 1996
- All 10th grade in 1997

Control samples were created for each year. In defining the samples our objective was to match the control and Explore cohorts by the number of years they have been in the Union City school system. How long students have been in Union City schools is an important control variable for two reasons. First, Union City is a traditional point of entry for newly arriving immigrants. As new arrivals to the U.S., students do not perform as well as U.S. students who have been in the system longer. As of the fall of 1995, when the Explore students left the Columbus Middle School and entered Emerson High School, no new students were admitted into the Explore program. As a result, Explore students have been in the Union City schools for at least one year, and in the majority of cases two years, by the fall of 1995. This is an important consideration in a district where an average of 24% of students are new each year.

The second reason to define a sample based on years in the Union City school system has to do with the comprehensive reform efforts undertaken by the district. A key goal of this study is to investigate the impact of technology when coupled with a deep and substantial program of educational reform. New students transfer into the Union City schools from districts that have their own approaches to teaching and learning. Therefore, controlling for length of time in the Union City school system ensures that both the Explore and control groups have a similar proportion of new arrivals.

Given the differences between 7th grade and 8th grade entrants to Project Explore, we decided to perform analyses to examine distinctions between these two groups. For each subgroup we selected random control groups comparable in terms of grade level and years in the Union City school system. For the 7th grade entrants a new control sample was established for each year of the project. This ensured that our control group had been in the district for the same length of time as the Explore cohort and was of comparable size. For 8th grade entrants we established a control group that was comparable in terms of LEP status and years in the district.

The number of records used in the statistical study is slightly lower than the number of overall participants in Project Explore. For reasons of standardization, only students who had been tested in all three core subjects for each year of the project are included in the analysis. The actual number of records dropped is quite small (See Table 5). Inspection of the untested students does not indicate any pattern among students being excluded from the testing cycle. Limited English Proficiency (LEP) status, for example, was not a factor in missing a score.

Table 5. Total Number of Students in Project Explore by Year and Number of Students with Complete Test Data

Year	Total	Full Test Data
1994	135	113
1995	135	125
1996	99	95
1997	69	63

The following analyses are based on mean scores, proficiency levels, and *t*-tests for each year of the project. Mean scores are a more accurate measure of a cohort's performance on standardized tests than the more general measure of student passing rates, and enable us to conduct a robust analysis of student performance between the Explore and control groups. We also present the distribution of these two groups across proficiency levels, and, in a third analysis, we present independent sample *t*-tests on the Explore cohort scores and the control sample scores drawn from the district population.

1993-1994: Seventh Grade Results

The mean test scores on the EWT administered at the end of the 7th grade (Spring 1994) show strong gains made by the Explore students compared to their grade level cohort (see Figure 15). Explore students are scoring higher in all subject areas. The greatest differences are in math (a mean of 33.7 as compared to 26.6 for the district), and writing (71.4 versus 64.5 for the district).

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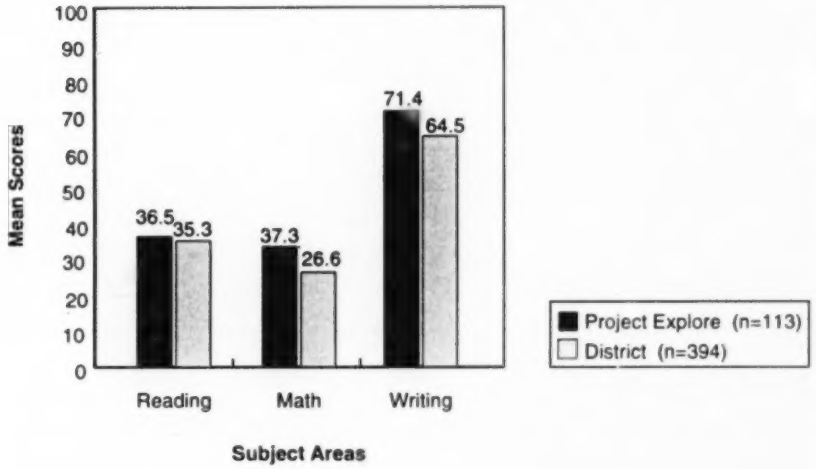
Figure 15. 7th Grade EWT Mean Scores for Project Explore and District



The data on proficiency levels for the 7th grade EWT also illustrate a greater accomplishment by the Explore cohort as a larger percentage of Explore students are in Levels 1 and 2 (see Figures 16, 17, 18). The distribution is particularly striking in mathematics, where a full 26% of Explore students are at the highest level (Level 1), while only 7% of the general population falls in that level. In addition, twice as many Explore as general students fall into the top level in writing (13% compared to 6%).

Figure 16. Percentage of Project Explore and District Students at Each Reading Proficiency Level for 7th Grade EWT

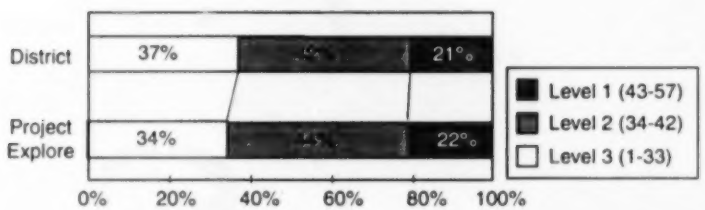


Figure 17. Percentage of Project Explore and District Students at Each Math Proficiency Level for 7th Grade EWT

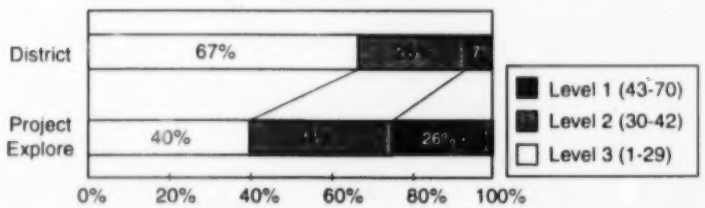
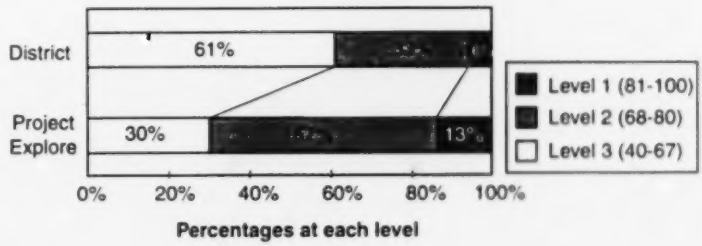


Figure 18. Percentage of Project Explore and District Students at Each Writing Proficiency Level for 7th Grade EWT



To statistically examine these differences, independent sample *t*-tests were run on a control group drawn from the general population to test the null-hypothesis of no difference between the two cohorts. The results, shown in Table 6, indicate the differences between the two groups in mathematics and in writing are statistically significant at the .001 level in both instances.

Table 6. *T*-Test on Mean Scores on 7th Grade EWT Test for Project Explore and Control Group

	Reading	Math	Writing
Project Explore (n=113)	35.1681	33.6814	71.14
Control Group (n=113)	36.5133	26	64.59
df=224 cr= ± 1.96	t= -1.22 p<.22	t= -5.10 p<.001	t= -4.64 p<.000

These results indicate that during the first year of Project Explore, the Explor e students do significantly better than non-Explore students in math and writing.

1994-1995: Eighth Grade Results

The EWT administered in the 8th grade is a different version from the test administered in 7th and 9th grade. It varies from the other versions in that it is marked on a 200-point scale, rather than a 100-point scale. This difference is reflected in the overall means for the two student populations (see Figure 19). Project Explore students continued to score higher than their district counterparts. The greatest difference is again in writing (136.3 compared to

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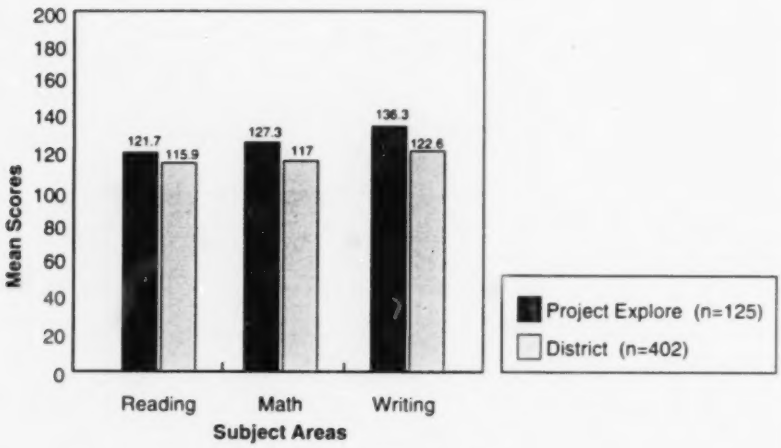
122.6 for the district), followed by math (127.3 for the Explore cohort compared to 117 for the district).

Figure 19. 8th Grade EWT Mean Scores for Project Explore and District



The distribution of proficiency levels for Explore and non-Explore students indicates that, overall, the Explore cohort continues to do better than their non-Explore peers, particularly in math and writing. In math 27% of Explore students are at the top proficiency level, while only 18% non-Explore students score at this level. In writing, 46% of Explore students are in level 1 as compared to 37% of non-Explore students (see Figures 20, 21, 22).

Figure 20. Percentage of Project Explore and District Students at Each Reading Proficiency Level for 8th Grade EWT

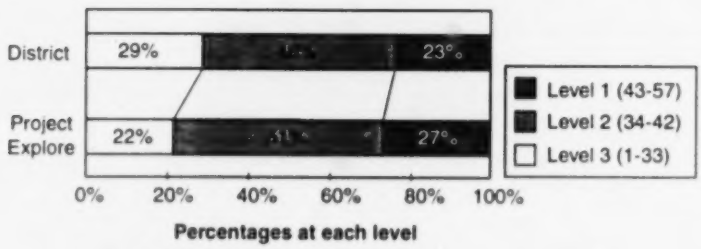


Figure 21. Percentage of Project Explore and District Students at Each Math Proficiency Level for 8th Grade EWT

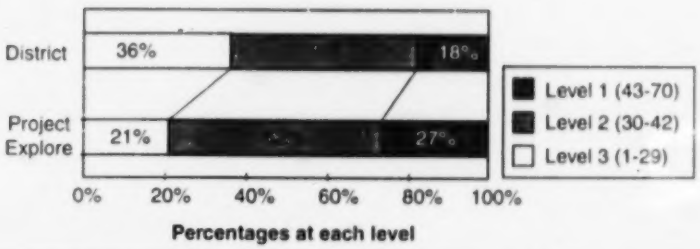
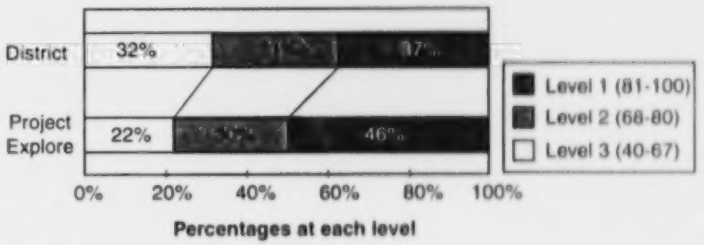


Figure 22 - Percentage of Project Explore and District Students at Each Writing Proficiency Level for 8th Grade EWT



Despite these differences, when we conducted independent *t*-tests on Explore and a control group, no significant differences were found in any subject area (see Table 7).

Table 7. *T*-Test of Mean Scores on 8th Grade EWT Test, for Project Explore and Control Group

	Reading	Math	Writing
Project Explore (n=125)	121	126.8	135.9
Control Group (n=124)	120.3	120.3	124.6
df=186 cr= ± 1.96	t= 0.15 p<.88	t= 1.44 p<.151	t= 1.6 p<.112

This finding prompted us to look more closely at the distribution of scores across proficiency levels. As can be seen from Figures 20 through 22, approximately one-fifth of the Explore cohort is scoring at the lowest level. It was at this juncture in our analysis that we decided to see if there was a difference in performance between 7th grade and 8th grade entrants to the program.

Table 8 shows the mean 1995 EWT scores for 7th and 8th grade Explore entrants. The differences between these two groups are pronounced: the 7th grade entrants have a mean score that is 62.3 points higher in writing than 8th grade entrants, 41.2 points higher in reading, and 32.6 points higher in math.

Table 8. 8th Grade EWT Mean Scores for 7th and 8th Grade Entrants to Project Explore

	Reading	Math	Writing
7th Grade Entrants (n=94)	131.7	135.3	151.7
8th Grade Entrants (n=29)	90.5	102.7	89.4

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Comparing the 7th grade Project Explore entrants to the district students as a whole reveals different results than when comparing the entire Explore cohort. Figures 23 and 24 show the mean scores for the 7th grade entrants to Project Explore compared to the district as a whole as well as to those district students already in the system by the 7th grade. The 7th grade entrants to Project Explore have noticeably higher scores than the general district population. This is most likely due to the large portion of new students and new immigrants within the general district population.

Figure 23. 1995 EWT Mean Scores for 7th Grade Project Explore Entrants and District

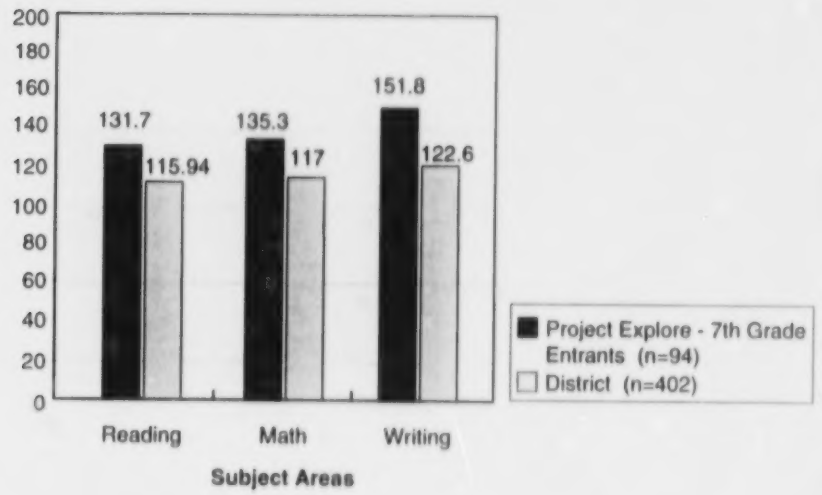
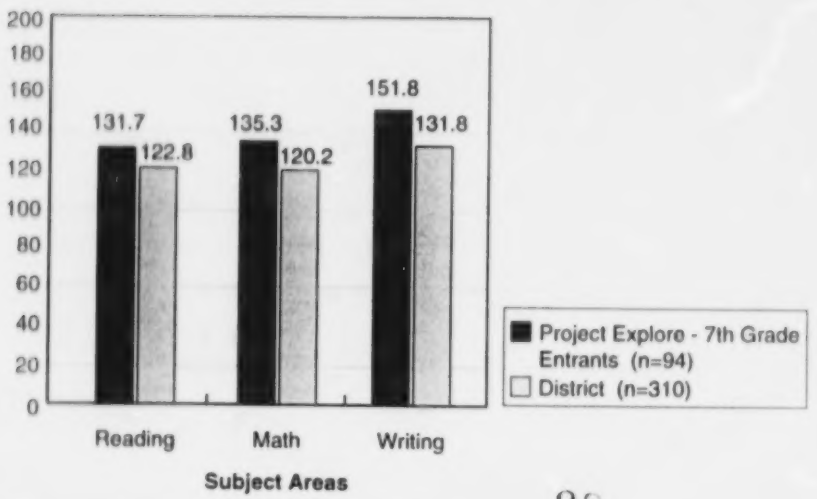


Figure 24 - 1995 EWT Mean Scores for Project Explore 7th Grade Entrants and District 7th Grade Entrants



Controlling for time spent in Union City schools, we compared 7th grade entrants to Project Explore with non-Explore students in Union City schools since the 7th grade. In this comparison, the 7th grade entrants to Project Explore continue to exhibit higher mean scores across all subjects. On the 8th grade EWT, the 7th grade entrants to Project Explore maintain this advantage with the clearest difference being in writing (151.8 compared to 131.8) and in mathematics (see Figures 23 & 24 above).

Independent sample *t*-tests run on the 7th grade entrants to Project Explore and a control group of non-Explore students show significant differences in mathematics and writing at the 0.01 level (see Table 9). These results indicate that for the original Explore cohort, performance in mathematics and writing is substantially different than a control group of non-Explore students. Reading scores, however, are not significantly different from those among the non-Explore students.

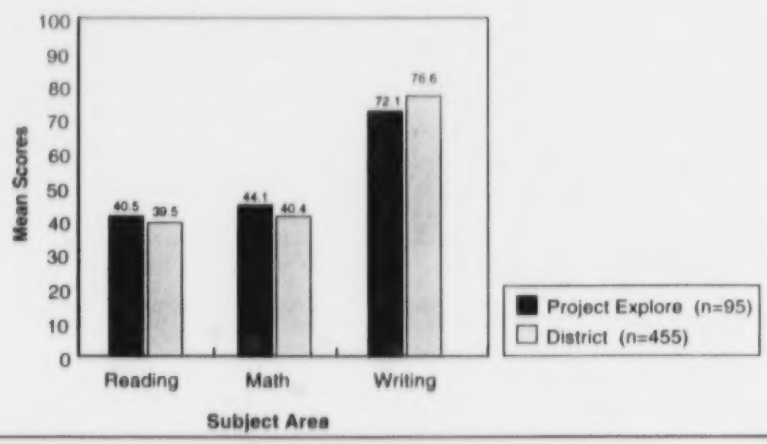
Table 9. *T*-Test on Mean Scores on 8th Grade EWT Test for 7th Grade Entrants to Project Explore and Control Group

	Reading	Math	Writing
Explore - 7th Gr. Entrants (n=94)	131.7	135.3	151.7
Control Group (n=92)	124.2	122.4	132.5
df=184 cr= 1.98	t=-1.45 p< .149	t= -2.54 p< .012	t= -2.72 p< .007

1995-1996: Ninth Grade Results

Ninth grade was the first year in high school for the Project Explore students. The move to Emerson High School also meant that the Project Explore students no longer make up the entire class but are mixed with students from other schools. The mean scores on the 9th grade EWT show that the gap between the means for Explore and non-Explore is narrowing, and in one subject has actually inverted (see Figure 25). In writing the general population has a higher mean score (76.6) than Project Explore (72.1).

Figure 25. 1996 EWT Mean Scores: Project Explore vs. District



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Despite the drop in mean scores, Project Explore students still fall solidly above the passing cutoff into the higher proficiency levels (see Figures 26, 27, 28).

Figure 26. Percent of Students at Each Reading Proficiency Level on the 9th Grade EWT for Project Explore and the District

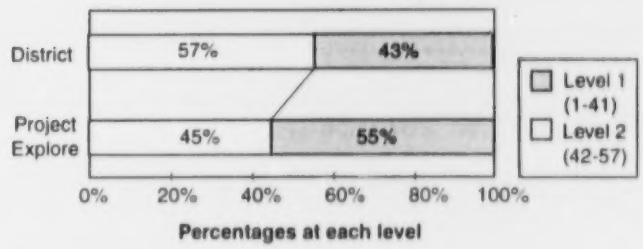


Figure 27. Percent of Students at Each Math Proficiency Level on the 9th Grade EWT for Project Explore and the District

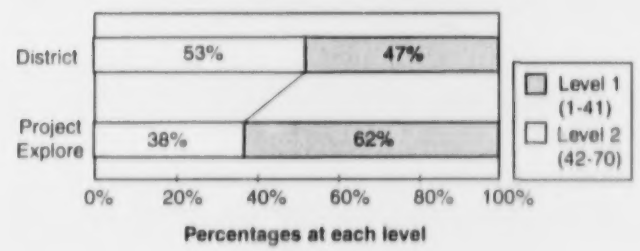
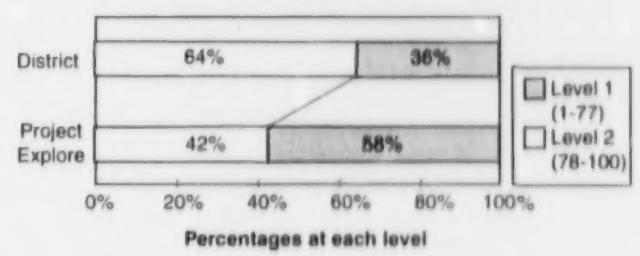


Figure 28. Percent of Students at Each Writing Proficiency Level on the 9th Grade EWT for Project Explore and the District



Figures 26 through 28 show the percentages of students scoring in the top proficiency level. (For the 9th grade EWT, the State Department of Education recommends dividing the students into two proficiency levels.) Returning to the early discussion of the chi-square analysis of passing rates, participation in Project Explore appears to have a connection with passing. Indeed, in every subject Project Explore has passing rates of over 50%, whereas the district cohort never breaks the 50% barrier.

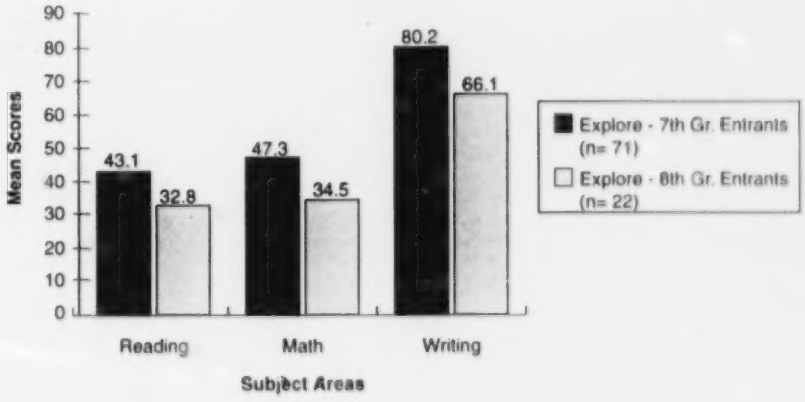
The independent sample *t*-tests run on the entire 9th grade Project Explore cohort and a non-Explore control group indicate significant differences in mathematics and writing. The results in mathematics tested significant at the .05 level, and writing at the .001 level (see Table 10).

Table 10. *T*-Test on Mean Scores on 9th Grade EWT Test Project Explore and Control Group

	Reading	Math	Writing
Project Explore (n=95)	40.48	44.08	76.61
Control Group (n=95)	39.12	39.86	70.93
df=186 cr= ± 1.98	t= -1.13 p<.259	t= -2.36 p<.019	t= -3.43 p<.001

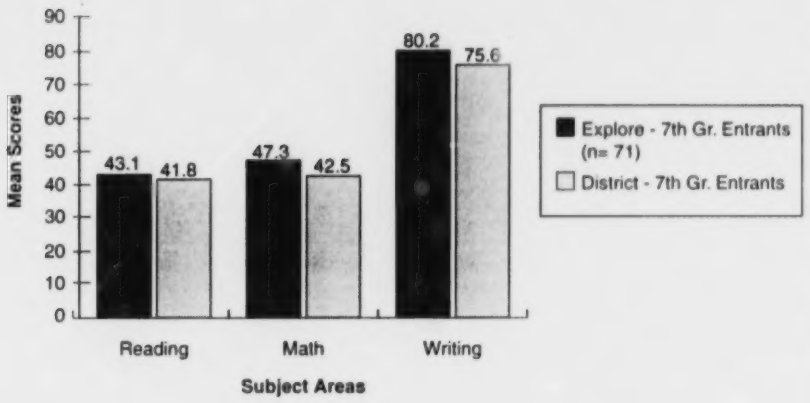
In the 9th grade, the difference between the 7th grade and 8th grade entrants to Project Explore still remains large. In reading, the 7th grade entrants to Project Explore have a mean score of 43.1 compared to 32.8 for the 8th grade entrants. In math, the 7th grade entrants have a mean score of 47.3 compared to 34.5 for the 8th grade entrants. In writing, 7th grade entrants have a mean score of 80.2 compared to 66.1 for the 8th grade entrants (see Figure 29).

Figure 29. Mean Scores on 9th Grade EWT for 7th and 8th Grade Entrant Cohorts to Project Explore



When compared to the district cohort, the 7th grade entrants to Explore are still scoring higher. However, when 7th grade entrants are compared to other students who also were in the district by the 7th grade, the gap between the two groups begins to narrow (see Figure 30). In mathematics, 7th grade entrants to Explore had a mean of 47.3 compared to 42.5 for the 7th grade entrants in the district, and 80.2 as compared to 76.6 in writing.

Figure 30. Mean Scores on 9th Grade EWT for 7th Grade Entrants to Project Explore and Comparable District Students



Although the gap is narrowing between the 7th grade Explore entrants and district students who have also been in Union City School District since 7th grade, *t*-tests still show significant differences in mathematics and writing between 7th grade Explore entrants and a control sample of 7th grade entrants from the district (see Table 11).

Table 11. *T*-Test on 7th Grade Entrants to Project Explore and Control Group Mean Scores, 9th Grade 1996 EWT Test

	Reading	Math	Writing
Explore - 7th Gr. Entrants (n= 71)	43.1	47.3	80.17
Control Group (n= 71)	41.8	42.8	74.89
df=140 cr= ± 1.98	t= -1.16 p< .247	t= -2.32 p< .022	t= -3.27 p< .001

1996-1997: Tenth Grade Results

In the 10th grade, Union City administers a version of the High School Proficiency Test (HSPT) that, in 11th grade, is used as a graduation requirement. On the HSPT, the performance of district students and the Explore cohort are very similar in reading and writing. In mathematics the Explore cohort maintains a substantial advantage over the non-Explore group (see Figure 31).

Figure 31. Mean Scores on 10th Grade HSPT for Project Explore and District Students

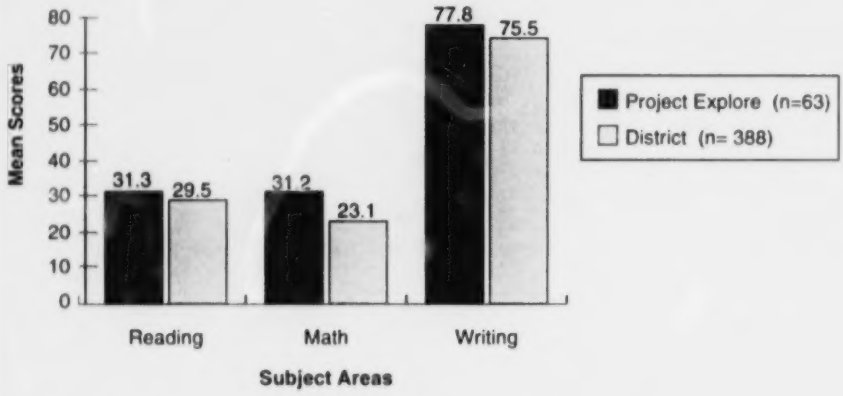
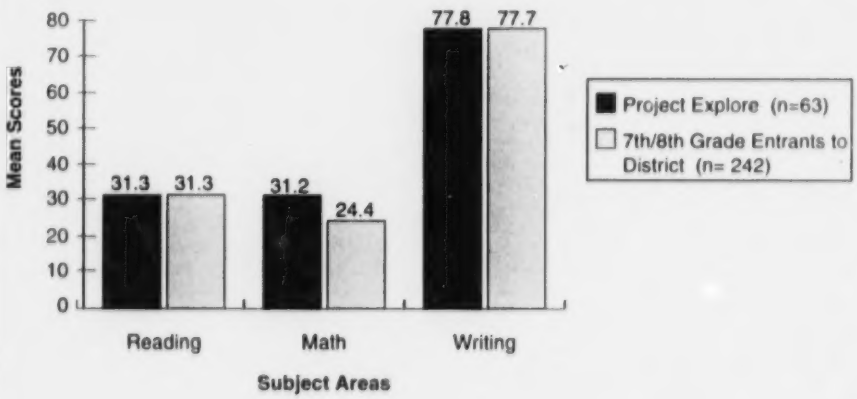


Figure 32 shows the means of all non-Explore students admitted to the district by the 7th or 8th grade. In reading and writing the means of this group are almost the same as the means of the Explore cohort. Only in math are the Explore students substantially ahead (31.2 for Explore and 24.4 for the district's non-Explore 7th and 8th grade entrants).

Figure 32. Mean Scores on 10th Grade HSPT for Project Explore and Comparable District Students



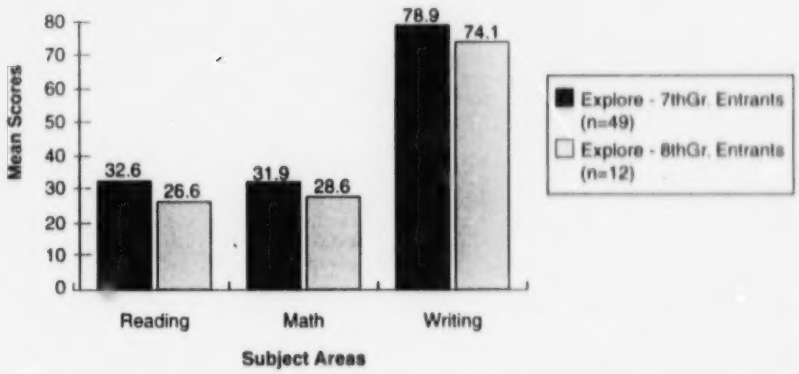
In *t*-tests comparing the Project Explore cohort and a control sample (selected from 7th and 8th grade entrants to the district), only the math results proved to be significantly different (see Table 12).

Table 12. *T*-Test on Project Explore and Control Group Mean Scores, 10th Grade 1997 HSPT Test

	Reading	Math	Writing
Project Explorer (n=63)	31.3	31.4	77.8
Control Group (n= 63)	31.4	24.7	77.3
df=124 cr= ± 1.98	t= .13 p< .894	t= -4.11 p< .000	t= -.35 p<.725

By the 10th grade the gap between the 7th grade and 8th grade entrants to Project Explore decreases substantially but the numbers of students in the 7th and 8th grade Explore subgroups are now smaller (see Figure 33). The 8th grade entrants have progressed in mathematics, and there is now only a 3.4 point difference in mathematics between 7th and 8th grade entrants. Reading represents the greatest difference at 32.6 for the 7th grade entrants and 26.6 for 8th grade entrants.

Figure 33. Mean Scores on 10th Grade HSPT for 7th Grade and 8th Grade Entrant Cohorts to Project Explore



Eighth Grade Entrants in Project Explore

The consistent differences in performance on the standardized tests between the 7th grade entrants in Project Explore and the 8th grade entrants prompted us to look closely at these two groups of students. As discussed above, the 8th grade entrant cohort is made up of more LEP students than the rest of Project Explore. Forty-two percent of the late entrants were LEP compared to only 12% of the early entrants. To achieve a better understanding of this late entry cohort, we drew a sample of district students who also entered the district in the 8th grade and had a similar proportion of LEP students.

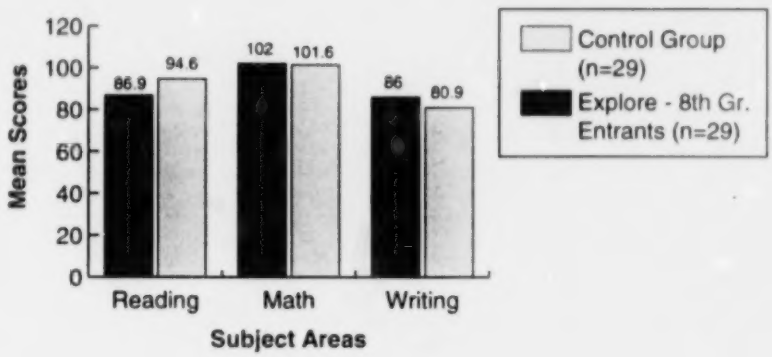
Table 13. Number by Years of 8th Grade Entrants to Project Explore and the Control Sample from the District

	Explore - 8th Gr. Entrants	District - 8th Gr. Entrants
1995	29	29
1996	22	15
1997	12	8

A sample of 29 students was selected from the district. Because the number of students in these subgroups of Project Explore decreases over time (see Table 13), they are matched to the same sample in all three years. This gives an indication of the rate of attrition, which is faster for the non-Project Explore students.

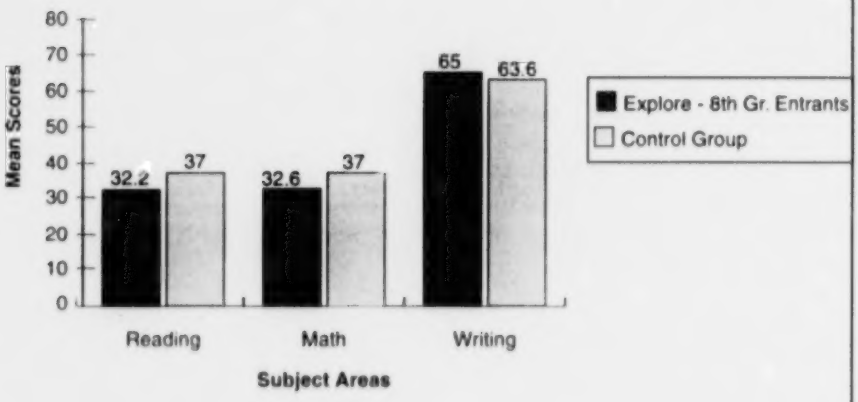
Reading scores on the 8th grade EWT for 8th grade Explore entrants are lower (86.9) than the control cohort (94.6) (see Figure 34). The two groups have the same mean in mathematics, while 8th grade Explore entrants are higher in writing (86 versus 80.8). None of these differences proved to be significant on independent sample *t*-tests.

Figure 34. Mean Scores on 8th Grade EWT for 8th Grade Entrants to Project Explore and Control Group



The 9th grade results (1996) indicate a small setback for the Project Explore 8th grade entrants. Their means are lower than those of the control group in every subject (see Figure 35). None of these results were statistically significant.

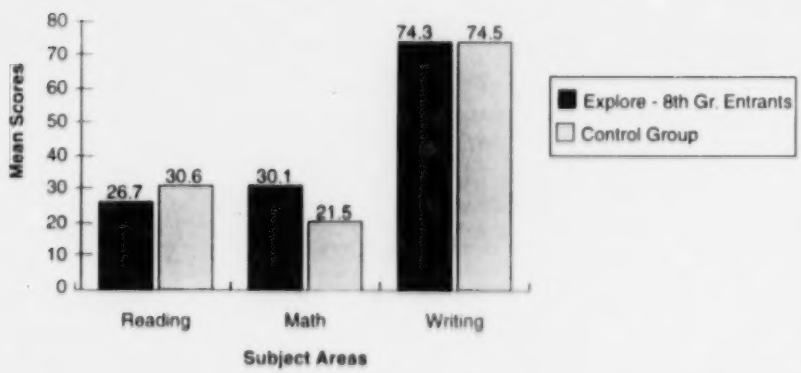
Figure 35. Mean Scores on 9th Grade EWT for 8th Grade Entrants to Project Explore and Control Group



It should be noted that a contributing factor to the lower means of the 8th grade entrants compared to the control sample is the substantial drop in the number of students in the control sample who are still in the district. Out of a control sample of 29, only 15 students remained by the 10th grade. Among the Explore group of 29 who started in the 8th grade, there were 22 students remaining.

By the 10th grade the numbers are difficult to compare because the control sample has dropped to 8 students and the 8th grade Explore entrants to 12. The Explore students have a higher mean in mathematics (30.1) compared to the control group (21.5). In reading the control group was higher (30.6 compared to 26.7), and in writing both groups were at 74 points (see Figure 36). Because of the small numbers involved no *t*-tests were done.

Figure 36. Mean Scores on 10th Grade HSPT for 8th Grade Entrants to Project Explore and Control Group



Experimental Algebra I Class

The higher performance of the Explore cohort on the mathematics portion of the EWT and HSPT test cannot be attributed to the use of technology. In the 8th grade, a subset of the Explore students were invited to participate in an experimental program at the Columbus school; these students took Algebra 1 in addition to their regular 8th grade math class. This extra algebra class had a substantial and lasting impact on students' performance on the standardized tests. To determine the impact of this group on the overall Project Explore cohort, we pulled out the 27 students in the 8th grade Algebra 1 class to examine their math scores. The results are reported below.

Table 14. Mean Math Scores on the 7th Grade EWT Test for Explore Students in Algebra 1 (in 8th Grade), Explore Students Not in Algebra 1, and the District.

	Math
Algebra 1 (n=24)	42.2
Not in Algebra 1 (n=90)	31.33
District (n=394)	26.6

Table 14 shows test results prior to the students' participation in the Algebra 1 class. Both Explore cohorts (those selected to participate in Algebra 1 and those not selected) are higher than the district. These scores are prior to the extra math instruction, and we can conclude that students' participation in Project Explore is making an early difference in students' mathematics performance. The students who, as 8th graders, were selected to participate in the Algebra 1 course scored higher than the students not selected for Algebra 1. This is not surprising given that only those students who scored at Level 1 on the 7th grade EWT were eligible to participate in the course.

Table 15. Mean Math Scores on the 8th Grade EWT Test for Explore Students in Algebra 1, Explore Students Not in Algebra 1, and the District.

	Math
Algebra 1 (n=27)	156.6
Not in Algebra 1 (n=98)	118.9
District (n=402)	116.9

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Table 15 contains the results for the 8th grade EWT after the 27 students took Algebra 1. The Algebra 1 subset are significantly outperforming both the other Explore students and their district peers. The non-algebra Explore group is performing similarly to the 8th grade district population. The gain in scores noted in the previous sections of this report between the Explore cohort and the district are due to the Algebra 1 pulling up the Explore mean.

Table 16. Mean Math Scores on the 9th Grade EWT Test for Explore Students with Algebra 1, Explore Students without Algebra 1, and the District

	Math
Algebra 1 (n=22)	53.8
Not in Algebra 1 (n=73)	41.2
District (n=455)	40.3

The performance difference between the students who had Algebra 1 and the other two subsets continues into the 9th grade. Table 16 contains mean scores for each of these three groups. As 9th graders these students participated in honors geometry and continued to significantly outperform both their Explore and non-Explore peers.

Table 17. Mean Math Scores on the 10th Grade HSPT Test for Explore Students with Algebra 1, Explore Students without Algebra 1, and the District (7th/8th Grade Entrants Only)

	Math
Algebra 1 (n=19)	35.5
Not in Algebra 1 (n=44)	29.3
District (n=242)	24.4

As 10th graders, the Algebra 1 cohort took honors Algebra II, and they continue to significantly outperform their peers.

Discussion

The design of this study enables us to take two different perspectives on the standardized testing results of students in the Union City School District. First, we looked broadly across schools and grade levels, at the impact of the reforms on the general student population. Second, we examined a cohort of students who have had *sustained access to technology at home and at school*, and a cohort of students who have had more limited, *school-only* access to technology.

The Impact of Educational Reforms

Our analysis of standardized testing data at the 1st, 4th, 8th, 9th, and 10th grade levels clearly indicates that the educational reforms have had a substantial impact on students' test performance, particularly at the K-8 level where the reforms have been in place the longest. The district began implementing the reforms in 1990, starting with early elementary grades and then moving on to upper elementary and middle schools. The high school reforms did not begin until 1995.

Improvements in students scores have been most pronounced at the middle school level, where scores have risen between 30 and 50 percentile points on the state mandated Early Warning Test. At the elementary grades scores have also improved dramatically; increases range from 45 percentile points for 1st grade reading to 14 percentile points in 4th grade writing.

CCT's long-term involvement with the district has allowed us to observe a number of factors that we believe have contributed to success at the elementary and middle school levels. These include:

- Instructional leadership at the building level (principals and curriculum resource teachers)
- Effective school improvement teams;
- Extensive professional development in the whole language approach and cooperative learning
- A strong emphasis on student creativity and the expression of ideas in multiple formats
- An emphasis on providing differential points of entry into a task for children working at different ability levels
- A de-emphasis on remediation and an emphasis on learning for all;
- Establishment of classroom libraries and adoption of a multi-text approach to learning that includes the integration of technology into instruction.

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While progress is being made at the high schools, change at this level has been slower and the results have been less dramatic. The reasons for this are numerous and are not unique to Union City. High schools are historically more departmentalized than elementary and middle schools. Faculty tend to work

exclusively within departments, making cross-departmental collaborations and curriculum integration difficult goals to accomplish. Students are more rigidly sorted into groups defined as those in need of remediation and those who are academically advanced. Principals often spend much of their time on nonacademic matters such as discipline, scheduling, and budgeting. Finally, teachers often feel torn between covering the content and teaching skills that can help all students learn how to learn. Despite these obstacles high school scores in Union City are on the rise, particularly in the areas of reading and writing.

The Impact of Technology

This study investigates the impact on students' performance on standardized tests of deep and sustained access to technology. It compares these students' performance to students who have also had access to technology, but in a far more limited and constrained context. Explore students had access at home and at school to software tools which included word processing, spreadsheet, and database programs. They also had both home and school access to communication and information resources including local and Internet email and the World Wide Web. The non-Explore control groups had school-only access to similar technology resources, and did not have access to email.

Our comparison of these two groups indicates that writing is the one area where depth of access to technology is making a difference in students' performance. Explore students do significantly better than their non-Explore peers on the 7th, 8th, and 9th grade writing portion of the EWT. This finding is consistent with other studies indicating that when word processing is fully integrated into the writing process, students are free to think about the higher level aspects of writing such as organization and clarity, and their writing skills improve (Bangert-Drowns, 1993; Reynolds & Hart, 1990; Wresch, 1987). Researchers have also found that regular use of email impacts favorably on students' writing ability (Margaret Riel, personal communication).

By the tenth grade there are no significant differences in the test scores of Explore and non-Explore students. We interpret this finding to mean that for those students who have been in the Union City schools for a minimum of four years, the reformed curriculum is leveling off any advantage the technology may have provided.

Although the Explore students' math scores are significantly higher than those of their district peers on 7th through 10th grade tests, these differences cannot be attributed to differences in technology access. The higher math scores of the Explore cohort are attributable to two factors. First, as 7th graders the Explore students did better than their district peers in all subject areas, an improvement we attribute to the high level of expectation and investment on the part of Bell Atlantic and district teachers and administrators in the Explore cohort. Second, as 8th graders a group of twenty-seven Explore students participated in a district pilot to offer Algebra I at the 8th grade level. These students went

on to participate in honors geometry at the 9th grade level and honors Algebra II at the 10th grade level. Their exposure to advanced math courses is responsible for raising the math test scores of the entire Explore cohort.

Finally, our analysis determined that students who entered the Explore program in its second year (as 8th graders) never do as well as the 7th grade Explore entrants, nor do they perform significantly better than their district peers. This finding is partly due to the fact that more of the 8th grade Explore entrants were recent immigrants with limited English proficiency. Additionally, these students were not exposed to the same level of expectation and anticipation that surrounded the 7th grade entrants.

Although the design of this portion of our research depends on a traditional independent-variable research model, which is structured to make claims about a direct relationship between a single, isolated intervention—the computer—and a single outcome—the test score, we have been sufficiently immersed in the work of the district to know that there are a number of contextual factors that have aided the Explore students' success. We also believe, however, that the *technology has facilitated* several important factors, and these, along with the context in which Project Explore originated, have contributed to the Explore students' overall success.

Contextual factors include:

- The setting of the Christopher Columbus Middle School where Project Explore was launched
- The high expectations for the students on the part of Bell Atlantic, district administrators, teachers, and a host of visitors from around the world
- The district's efforts to involve parents more extensively in the education of their children.

Technology-facilitated factors include:

- Increased communication between teachers, students, and parents;
- Increased collaboration among teachers
- Additional opportunities to write and edit
- Additional opportunities to undertake multimedia authoring projects.

The Christopher Columbus Middle School

The original setting for Project Explore was the newly opened Christopher Columbus Middle School. Columbus school faculty were selected from teachers district-wide and had to be willing to take on the challenge of learning to use what at the outset of the trial were state-of-the-art technologies. As a new school, both the faculty and the principal were intent on creating a school that would promote academic success for all students, and a critical measure for the school community was how well the students would do on the EWT test.

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In addition to the school principal, there were 16 teachers at the Columbus school, a guidance counselor, a resource room teacher, a library/media specialist, a computer teacher, and a nurse. The teaching staff consisted of 10 general program teachers, who taught science, math, social studies, and communications. Two teachers (Port-of-Entry) were responsible for Limited English Proficiency (LEP) students, who include the district's most recent immigrants. Four additional teachers worked in the district's Basic Skills Improvement Program, collaborating with the general program teachers to provide additional instruction to students considered academically at-risk. The resource room teacher also provided additional instruction to special education students, and the computer teacher provided instructional support for the further integration of technology resources into the curriculum. The teachers at Columbus represented a highly dedicated and strongly motivated professional community and were critical to the early success of Project Explore.

The principal, who in addition to providing strong academic and administrative leadership, ran a school environment in which the needs and concerns of teachers, students, and parents were given an active voice in the decision-making process. The Columbus school has been characterized by an open exchange of ideas, with decisions made collaboratively through school management team. Columbus is the only school in Union City to belong to the education reform group the Coalition of Essential Schools. The receptive atmosphere at Columbus made it possible for teachers and students to successfully implement and appropriate the reforms recommended by the district. Much of the credit for the achievements at Columbus rests with the principal and the support he has lent to his highly skilled teaching staff.

High Expectations

From the outset of the project, it was clear to all involved that Bell Atlantic and the Union City School District wanted the students in Project Explore to succeed academically. A number of events helped to create an atmosphere that drove this point home to the students.

First, there was the kickoff event for the students and their families. Bell Atlantic and school district officials spoke about the importance of the technology trial. They noted that this was the only project in the country to provide high-speed network access to students at school *and* at home, and they made it clear that they hoped students would take full advantage of capabilities offered to them by the new technologies.

Next, Bell Atlantic hosted a large public relations event for the project. Students, teachers, and district administrators were invited to attend. Local, state, and federal politicians spoke. The New Jersey State Commissioner of Education as well as representatives from the U.S. Department of Education talked about Project Explore as a milestone in education history. The CEO of Bell Atlantic provided opening remarks, and the principal of the Columbus school made it clear that he expected nothing less than their best from the students in the program.

Both these events were followed by numerous visitors who included members of the press, educators, business leaders, and state and national policy makers, all interested in learning more about Project Explore. Students were always involved in showing visitors around the building and sharing their experience of the project.

It wasn't long before the Columbus school became a site that the U.S. Department of Education frequently involved in videoconferences. Once again, students and faculty were asked to speak about their experiences to audiences all over the world.

Bell Atlantic has continued to host events for students and their families and regularly involves Explore students in speaking engagements around the country.

In February of 1996, President Clinton and Vice President Gore selected Union City as the site to announce a new multi-billion-dollar initiative, *America's Education Technology Challenge*. Union City was recognized by the President as a model of school-business partnerships and as a district that has used technology to further a comprehensive program of educational reform.

There is little doubt that these events have raised expectations for the Explore students. We also know from the research literature that high expectations combined with effective programmatic efforts are critical to ensuring student success (Campbell et al. in press).

Parent Involvement

As part of its district-wide program of reform Union City created "Parent University." This program offers a broad range of services to parents, including family math and science programs, ESL courses, expert advice on parenting skills, as well as cultural events. James Comer, the Director of the Yale Child Study Center, has amassed a mountain of evidence that clearly demonstrates that children do better in school when their parents are involved in their education (Ascher, 1988; Bauch, 1989; Becker & Epstein, 1982; Cochran & Dean, 1982; Comer, 1989; Comer, Haynes & Norris, 1991; Epstein, 1992). Union City's Parent University program plays a critical role in involving a community of parents who would otherwise be unlikely to get involved in their children's education.

From the outset of Project Explore, Columbus school teachers took deliberate steps to reach out to the parents of children in their building. Beginning in the spring of 1994, two teachers from the Columbus school decided to offer computer literacy classes to parents as an additional component of Parent University. The classes, now a regular Parent University offering, are designed to introduce parents to a broad range of computer applications.

The courses have been attended by over 300 parents, including parents who are and are not part of Project Explore. Parents have learned the basics of computer use, including how to use a mouse, navigate menus, and access applications and files. Participants then go on to learn to use a variety of tools including word processing software, graphics programs, spreadsheets, and databases.

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Several notable benefits are due in large measure to these course offerings. Teachers have commented that parents are now beginning to look at their children's productions with a more critical eye. As one instructor noted, "Parents, through our program, have become aware of the technology resources that students have at school for accessing and presenting information. As a result, they are making more demands on their children, mindful of the wealth of facilitating materials that are at their disposal."

Not only are parents more aware of what their children are able to do, but learning new technology skills has resulted in concrete benefits in the professional lives of some of the parents. Several parent participants have gotten better jobs, and as their instructor noted, "These are positions they would never have applied for had they not attended our classes."

In addition to the contextual factors making a difference in the overall performance of the Explore students, a number of other technology-related factors have made a difference in the learning of Explore students. The Center for Children and Technology is currently conducting three additional studies investigating the specific ways in which students, teachers, and parents are using networked technologies for both informal and formal learning purposes. The results of these studies will be forthcoming in the spring of 1998.

Increased Communication between Teachers, Students, and Parents

The communications capabilities afforded by email, online discussion groups, and listservs mean that the that teachers, students, and parents can engage in conversations more regularly and more easily than has ever been possible in the past.

We know from anecdotal reports recounted by teachers and students alike that since the inception of Project Explore, they have used the network to communicate with each other after hours. While we are in the process of collecting more formal data on exactly how teachers and students are using the network to communicate with each other, we know from conversations with teachers and students that requests for help with assignments are frequent (forthcoming, Center for Children and Technology, 1998).

When the Explore students were in their freshman year at Emerson High School, one teacher told us the following story:

> *My freshmen have been working on term papers that involve an interdisciplinary project between the history and English departments. Well, during the recent blizzard last week, while we were stuck at home one of the girls emailed me in a panic because she was unsure of some of the specifics of what she was supposed to be doing. We had many talks that week to clear up those points in question and I was able to tell her how to contact her English teacher through email. The problem was solved!*

Teachers have also used the network to communicate regularly with parents, and parents communicate with teachers about their children's progress and have raised questions about issues of concern.

Increased Collaboration among Teachers

As a tool for supporting communication among teachers, network technologies have shown much potential. Project Explore teachers have benefited enormously from opportunities to communicate with each other and with district administrators on a regular basis. In previous research, we learned that teachers engaged in conversations about curriculum issues and ideas for collaborative projects (Honey & Henríquez, April 1996). Some of the younger teachers reported using the network to seek advice from their more experienced colleagues. Teachers who were absent were able to communicate with their substitutes, a process that was important to maintaining continuity in the curriculum. And finally, teachers reported using the network to plan workshops for parents on how to use electronic mail.

As two teachers from Emerson High School told us:

> *I know that the ability to email other teachers after hours has helped tremendously to allow us to collaborate with each other. We are constantly sending each other new Web sites and communicating with each other on the events of the day, taking care of problems that would otherwise have fallen by the wayside.*

> *I have never had as much collaboration with other teachers as I have now. When we find sites of interest on the Internet, especially something that can be used in the classroom, we share the information with each other. And through email this becomes so easy. We don't have to look for each other in school, or wait until we have free time together.*

Opportunities to Write and Edit

In our earlier research we found that teachers who worked closely with students on their writing skills saw a marked improvement in students' ability to write (Honey & Henríquez, April 1996). There is little doubt that availability of the technology, at school and at home, played an important role in supporting this improvement. As one Columbus teacher said:

> *It has been an invaluable tool in my classroom — I find that my children want to write more, and they are reading more because they are using the computer — and it is very patient. They are corresponding with each other, and they are corresponding with me through email. And they are writing a lot of their reports on the computer. They are doing this in classes and at home.*

Communications and resource room teachers reported that students made use of Microsoft Works and Microsoft Publisher to do much more writing and publishing in the classroom than had been true of students in previous years. They noted that students' interest in writing projects increased over time, with many students spending their lunch period in the media resource room working on reports.

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Opportunities to Produce Multimedia Authoring Projects

During the spring of 1996, the Center for Children and Technology worked with administrators in the district to design a summer course for high school students to develop Web sites for local community-based agencies. The course, "Business, Community, and Educational Applications of Technology," was approved by the Board of Education and ran for six weeks, five days a week, from 8:30 a.m. to 12:30 p.m., during the summer of 1996. Students who successfully completed the course received five high school credits.

As discussed above, the district's curricular emphasis has been on collaborative learning through project work, independent research, and communication of findings through reports and publications. This proved an ideal framework for the community Web-authoring effort. We also believed that well-designed Web-authoring projects would not only support but also enrich the district's student learning agenda. We knew at the outset that this project would involve levels of complexity not often demanded in other areas of students' work. The kinds of skills and understandings that we were interested in helping students to develop included the following:

- Mastery of content knowledge
- Gathering, interpreting, and synthesizing information
- Knowledge of design principles (what constitutes good design)
- Awareness of audience (whom are we making this for and in what are they interested?)
- Technical complexity
- Ability to collaborate (identifying and distributing tasks, trust, ability to reassemble)
- Critique and revision.

The success of the "Business, Community and Educational Applications of Technology" course has been widely recognized by educators and community members throughout the district. A number of tangible outcomes have resulted from this effort, including:

- Students from the summer course, on their own, initiated an HTML training course for their classmates. The class meets once a week and the students are planning to teach elementary students in the spring.
- Several students have begun to create Web pages for local businesses as afterschool jobs.
- The Board of Education has adapted the business course model as part of its regular curriculum. Teachers are working with teams of students to create multimedia presentations. Students are helping teachers to develop their technical skills, and teachers are helping students to develop research skills by synthesizing multiple sources of information.
- Students have presented their work to several prominent audiences, including the New Jersey Education Summit and Governor Christine Todd Whitman; the New Jersey State Board of Education; the U.S.

Department of Education's Office of Bilingual Education and Minority Language Affairs; and the National Science Foundation.

- The district has approved "Business, Community, and Educational Applications of Technology" so that it was run again in the summer of 1997. While CCT continued to provide some assistance, the course was officially run by Union City teachers and administrators.

While we have no hard proof that these kinds of authoring projects are making a difference in the test scores of the Explore students, the district's director of academic programs believes that one reason the Explore students continue to excel in mathematics is the kinds of skills they have acquired in learning how to design and author Web pages.

Five Factors for Success

The story of Union City is remarkably compelling, offering evidence that the American dream is still a possibility. The success of the Explore students, as well as improvements seen in the district population as a whole, demonstrates that public education can work and that schools can be re-crafted to meet the diverse needs of children's cultural and learning experiences. The tale of Union City is as complex as it is successful. It would be nice if it offered up a formula for success — a one-size-fits-all model of education reform. Unfortunately, in an educational system that prides itself on plurality, a uniform model for change is an impossibility.

We can, however, identify key aspects of Union City's success that other districts can learn from and determine how to interpret and implement locally in their own school communities. While changes in educational philosophy, design, and implementation of the curriculum have been central to the district's success, a number of other comprehensive changes have also been undertaken during the past seven years. These additional reforms have helped to establish both a climate and an infrastructure that support and embrace innovation. These are the factors that we believe other school communities can learn from:

- Leadership and collaboration
- Strong base of teacher support
- Teachers at the center of curricular revision and school decision-making
- Sufficient funding from a variety of sources
- Attention to public relations.

Key Parties Working Together

Crucial to the Union City efforts has been support from the district leadership, including the superintendent, the Board of Education, and the teachers union. Union City's chief educational leader, Superintendent of Schools Thomas Highton, created an environment in which senior administrators felt they could take risks and make fundamental changes without risking their personal reputations or employment. This support enabled the Executive Director of Academic Programs, Fred Carrigg, to spearhead a yearlong research and planning process during the 1989-1990 academic year. A committee consisting of teachers and curriculum supervisors was formed to conduct an extensive review of the literature on successful teaching and learning. Obtaining solid evidence that would justify the move from a fact-based curriculum to one grounded in whole language, cooperative learning, and inquiry was essential to gaining top-level support. This yearlong process resulted in the district's Corrective Action Plan, the document that established the foundation for the district's restructuring efforts.

A Strong Base of Teacher Support

Another critical piece of the district's success has been a strong commitment to involve teachers at every level of the curriculum reform and restructuring process. Project Explore, along with the district as a whole, has benefited by capitalizing on teachers who were willing and motivated to bring about change and incorporate new technologies into the teaching and learning process. When the process of restructuring the curriculum began to be implemented in 1990-91, Mr. Carrigg had a strong base of teacher support on which to draw and build. As the former head of the district's Bilingual/ESL program (one of only two programs that were not failing in 1989), he had worked closely with more than a third of the district's eight hundred teachers. Many of the district's Bilingual/ ESL teachers were involved in the early process of rewriting the curriculum and restructuring their classrooms. They supported the changes being instituted and many of their classrooms became demonstration sites where teachers could come and observe firsthand the impact that the reforms were having on students' learning. And, just as having a base of support upon which to build was critical to the success of the curriculum reform efforts, for more skeptical teachers, having an opportunity to look before they leapt was key to building momentum at each of the district's schools. Equally important was the voluntary nature of this effort; no one was required to participate in the restructured curriculum until he or she was ready.

Teachers at the Center of Curricular Revision and School Decision-Making

During the past six summers, teams of teachers have created and revised curriculum, worked to identify and integrate technology resources, and participated in substantial professional development. This process has not only facilitated ownership over the reforms among the teachers, but it has also usually meant the presence of a knowledgeable teacher at the building level who is able to aid colleagues in implementing new curricular ideas and practices.

Teacher ownership over decision-making has been further facilitated by the establishment of building-level School Improvement Teams (SIT), made up of teachers, students, and parent representatives. Prior to the reforms, each school's budget was tightly controlled by central office. Teachers had little knowledge of how monies were expended and no input into budgetary decision-making. The establishment of School Improvement Teams has dramatically shifted the locus of control. Each school's SIT is allocated funds — $200 per student — to spend as it sees fit. In addition, school budget and central office expenditures are reviewed with SIT team members, and there is opportunity for teachers to provide administrators with feedback on the most effective use of monetary resources.

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Sufficient Funding from a Variety of Sources

In 1990 the New Jersey legislature passed the Quality of Education Act (QEA), which redirected education funding from more affluent suburban communities to the big urban districts. Union City has invested these monies in technology and in teacher professional development. Additional funds that have come to the district through a National Science Foundation grant and through the National Science Foundation State Systemic Initiative (NJ/SSI) have been used effectively for similar purposes. In addition to the above, the collaboration with Bell Atlantic has proved invaluable in a number of crucial respects. One of the most notable consequences of Project Explore has been a district-wide growth in understanding the importance of networking resources and tools for the community as a whole. Due in large part to the success of the technology trial, the district has committed substantial resources to building a comprehensive and scalable networking infrastructure that links the schools, city offices, and public libraries to the Internet.

Attention to Public Relations

One of the lessons learned in conjunction with the district's partnership with Bell Atlantic has been the importance of public relations and communication about success. While collaborations with outside entities are often touted for bringing additional resources to a district, business partnerships can bring a public relations capacity that helps both the local community and those outside to see, understand, and reflect upon the significance of their accomplishments. Union City's partnership with Bell Atlantic has raised awareness at both local and national levels about the importance of school reform and restructuring.

During the first phase of Project Explore, Bell Atlantic launched an enormous public relations effort that helped get out the real story of Union City. The magic lay not exclusively in the technology, but in the interweaving of a systematic program of educational reform with the judicious use of technology-based resources. While the technology proved to be an enormously valuable learning tool, the story communicated throughout the district as well as the country is one about the importance of educational reform and restructuring. Bell Atlantic's publicity campaign, whether intentionally or not, has played an extremely important role in communicating to education decision-makers that school reform and restructuring are essential components of successful technology integration efforts.

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